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Fiorinia Externa Ferris, A Scale Insect of Hemlock

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The scale insect, *Fiorinia externa* Ferris, is a pest of hemlock (*Tsuga* spp.) in the Eastern United States. This sucking insect belongs to a group called the armored scale insects that are important pests of agricultural and ornamental plants. First discovered in 1908 at Queens, N.Y., it has spread slowly into surrounding States. Apparently it was accidentally introduced from the Orient. Though all major infestations are of ornamental plantings, it has become established in native hemlock stands in at least two places (Connecticut and Wissahickon Park, Philadelphia). Fortunately these infestations have been localized.

Fiorinia externa injures hemlock by sucking juices from the needles. Heavy populations cause foliage yellowing, needle loss, a thin crown, and eventually death. Control is especially difficult because developing stages overlap. Though the scale is now restricted to definite areas, it seriously threatens native eastern (Canada) hemlock stands throughout this hemlock's range.

Hosts and Distribution

Besides eastern or Canada hemlock (*Tsuga canadensis* (L.)

Carr.), the principal hosts are Carolina hemlock (*T. caroliniana* Engelm.), and Japanese hemlock (*T. diversifolia* (Maxim.) Mast.) Yews, fir, and spruce may also be attacked but are not preferred hosts.

The distribution of this scale is not continuous but is restricted to the Eastern United States from coastal Connecticut to Maryland. Occasional infestations reported from inland cities probably result from shipment of infested plant material. The known distribution is—

Connecticut—Counties of Fairfield, New Haven, New London, and Middlesex

Maryland—Baltimore environs

Massachusetts—Marion

New Jersey—Moorestown and Orange

New York—All of Long Island, Westchester County, and Albany

Ohio—Kent

Pennsylvania—Philadelphia and environs.

Virginia—Richmond

Washington, D.C.

Evidence of Infestation

A heavily infested tree is easily spotted because of the unhealthy color of its foliage. Wax secretions of the scales give the underside of affected foliage a whitewashed appearance, especially in the spring and fall when crawlers are most numerous. When scales (fig. 1) are numerous, their feeding causes

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Figure 1.—Hemlock scales on underside of hemlock needles (about $\times 9$).

needles to turn yellow and drop prematurely, leaving a very thin crown.

Effect on Host Tree

Like all scale insects, this one sucks nutrients necessary for host plant growth. Excessive loss of nutrients reduces growth and vigor and causes the yellowing of foliage, needle loss, and possible death of the tree.

Microscopic studies reveal that the threadlike mouth part penetrates directly to the internal cells through the cuticle or stomatal openings on the needle underside. Even when the insect is immotile, its long flexible mouth part permits it to feed extensively in needle tissue.

Description

The egg-laden female is yellow and lives within the cast skin of the last immature molt (fig. 2). As the female matures, this white covering becomes reddish brown. Behind the female scale, many yellow eggs are deposited in two rows with their ends meeting at the median longitudinal axis of the cast larval skin.

Young scales, known as crawlers, hatch from these eggs and escape from under the female covering. The crawlers are small, lemon-colored, active insects with legs and antennae and can be seen only with the aid of a magnifying glass (fig. 3).

Adult males are minute, yellow with red eyes, and winged. After they have emerged, the scales may



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Figure 2.—Adult female showing general body outline (excluding scale cover) and eggs within the body ($\times 100$).



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Figure 3.—Crawler of *Fiorinia externa* ($\times 100$).

remain attached to the underside of needles. The scale covering is also white and elongate but narrower than that of the female.

Life History

Fiorinia externa has one or more generations each year, the number seeming to depend on location. Two generations are reported from Connecticut and Maryland but only one and a partial second from New York.

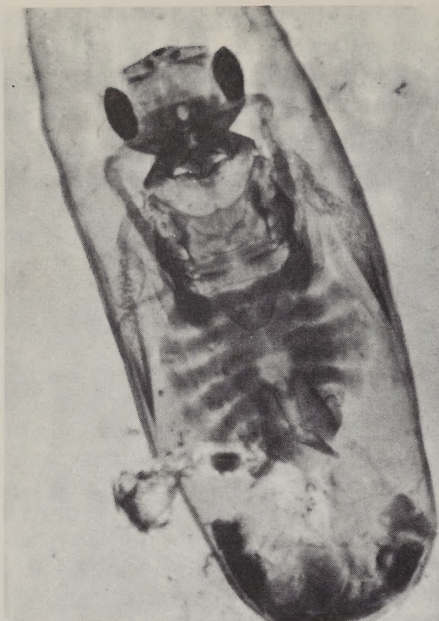
A generation typically begins with eggs being deposited under a female scale and hatching in about a month. These first-instar nymphs (crawlers) emerge from under her body and migrate to the new growth of the host tree. In hours the crawlers settle on a needle, insert their mouth parts, and begin to feed. After feeding for a month, the crawlers undergo their first molt and become immotile. The legs and antennae are discarded with the old cuticle. Male and female scales are now distinguishable. About a month is required for the winged male to develop and emerge from under its waxy covering. Male emergence continues until cold weather inhibits activity.

The immature female remains fixed to the needle and secretes over herself a flattened, elliptical scale about 1.5 mm. in length. A month after the first molt, the female molts for the second and last time. Now mating takes place. Eggs are deposited about 2 months after mating.

Three to four months are required for the female to mature and begin depositing eggs. Once mated, the female lays a variable number of eggs during her lifetime. Though winter weather may curtail egg production, she resumes activity in the spring. This long oviposition results in a great overlap in the various developmental stages and complicates control.

Control

Natural—Several small Hymenoptera have been reported as para-



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Figure 4.—The wasp *Aspidiotiphagus citrinus* (Craw.) parasitizing a female hemlock scale ($\times 100$).

sites of this scale insect. Of six parasites found in New York, the wasp *Aspidiotiphagus citrinus* (Craw.) (fig. 4) was the most common. In Maryland an unidentified chalcid, *Prospaltella* sp., was most abundant, but was also ineffective in controlling the scale population. The coccinellid *Chilocorus stigma* (Say) can be found in most infestations, but is not very effective in reducing numbers.

Chemical—Control of *Fiorinia externa* is difficult because the crawlers hatch throughout the summer. Conventional insecticides have proved inadequate even when applied repeatedly. The systemic insecticide, dimethoate, has effectively controlled both the crawlers and settled females. A spray of $1\frac{1}{2}$ pints of 30.5 percent dimethoate

emulsifiable concentrate in 100 gallons of water applied to foliage when the crawlers are first active in May gives adequate control. A similar application in July is necessary for thorough control or to curb a heavy infestation.

Caution:—Dimethoate is poisonous. Handle it with care. Follow the directions and all precautions on the container label. Store away from all foods. Improper use and disposal of unused portions can be dangerous to humans, domestic animals, desirable plants and pollinating insects, fish, and wildlife and can contaminate water supplies.

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